

Contouring Crown Aesthetics of a Traumatized Ankylosed Tooth Using Preformed Transparent Polypropylene Thermoplastic Template

S. Nagarajan M. P. Sockalingam, Ahmad Shuhud Irfani Zakaria, Prasanna Chandraseharan

ABSTRACT

Tooth ankylosis is a disastrous sequela of dental trauma that often leads to unaesthetic tooth appearance, especially in the anterior region. The altered dental aesthetic can significantly impact young adolescents' quality of life and general well-being. This case describes a clinical method to address the aesthetic concern of a 14-year-old young adolescent with a displaced traumatized ankylosed tooth using a preformed transparent polypropylene thermoplastic template. This template allowed recontouring of the tooth in terms of shape and alignment. This method provides an inexpensive option to correct the contour and alignment of a tooth with minimal material wastage, shortening the clinical working time and pleasing aesthetic outcome. As clinicians, one should explore all options and possibilities to work out a solution for a problem. The preformed transparent polypropylene thermoplastic template is one such option that can be used to address dental aesthetics.

Keywords: ankylosis, infraocclusion, replacement resorption, root resorption.

Published Online: October 03, 2023

ISSN: 2684-4443

DOI: 10.24018/ejdent.2023.4.5.297

S. N. M. P. Sockalingam*

The National University of Malaysia,
Jalan Raja Muda Abd Aziz, Malaysia.
(e-mail: drnaga67@ukm.edu.my)

A. S. I. Zakaria

The National University of Malaysia,
Jalan Raja Muda Abd Aziz, Malaysia.
(e-mail: shuhud_zakaria@ukm.edu.my)

P. Chandraseharan

The National University of Malaysia,
Jalan Raja Muda Abd Aziz, Malaysia.
(e-mail:
prasannachandraseharan@gmail.com)

**Corresponding Author*

I. INTRODUCTION

Traumatic Dental Injuries (TDI) can cause a myriad of sequelae [1], [2]. One such sequela of TDI is external root resorption (ERR) [3]. There are three common types of ERR related to TDI reported in the literature, namely inflammatory root resorption (IRR), transient (TRR), also known as surface root resorption and replacement root resorption (RRR), or ankylosis [3]. Surface resorption is often transient and non-progressive as long as the pulp tissues of the traumatized teeth remain vital. IRR is usually more extensive and commonly seen with severe luxation injuries. In IRR, pulpal necrosis with severe damage to the periodontal ligament and precementum root lining is often present. RRR refers to bony remodeling of the resorptive root areas of traumatized teeth. RRR is widely seen in reimplanted avulsed teeth because of dried or improper handling of the periodontal ligament [3].

One of the clinical shortcomings of RRR is infraocclusion of the traumatized teeth [4]. Infra-occlusion of teeth because of ankylosis, particularly in the anterior segment of the dentition, can result in poor dental aesthetics. Dental aesthetics is integral to growing children's psychological and social well-being, especially young adolescents [5]. Unpleasant dental aesthetics is often associated with poor oral health-related quality of life in children [6].

Many management options to treat ankylosed infraoccluded teeth were reported in the literature. However, sound evidence to support the most appropriate treatment to treat such a condition is relatively weak [7], [8]. Factors such

as patients' treatment compliance, parental commitment to long-term treatment, parental financial status, severity and prognosis of the ankylosed infraoccluded teeth, and clinicians' expertise may dictate the type of treatment to be carried out.

This case aims to illustrate one of the treatment options that can be undertaken to deal with the unaesthetic appearance of an ankylosed tooth with a poor prognosis using a preformed transparent polypropylene thermoplastic template.

II. CASE PRESENTATION

A 14-year-old girl with a history of traumatic dental injury to one of her maxillary permanent incisors was referred by a general dental practitioner (GDP) to the Paediatric Clinic, Faculty of Dentistry, the National University of Malaysia. The girl's parents were concerned about the alignment and unaesthetic appearance of their child's traumatised tooth.

Based on the parents' narrative and GDP's referral letter, four years ago (2018), the girl had a fall from a bicycle and had her left maxillary permanent central incisor (tooth 21) avulsed. The tooth was reimplanted a day after the trauma and splinted for four weeks. The avulsed tooth was stored in ice by parents before reimplantation. Root canal treatment was initiated two weeks after splinting. The prepared canal was initially filled with non-setting calcium hydroxide and Ledermix® mixture paste for two weeks and later replaced with non-setting calcium hydroxide only. Apical external inflammatory root resorption was observed on the periapical

radiographs during the subsequent visits, although the tooth did not exhibit any pain or swelling. The external IRR was controlled after four non-setting calcium hydroxide intracanal medicament visits at two monthly intervals. However, the root length has decreased considerably due to the resorption. An apical barrier was felt within the canal, and obturation was performed using thermoplastic gutta-percha with OBTURA®, SybronEndo. Following obturation, some degree of replacement root resorption (RRR) was observed on periapical radiographs in the subsequent visits. The RRR has been progressive at a slow pace over the years. The parents were advised of the poor prognosis of the tooth. Alternative options, such as decoronation or tooth extraction, were offered to the parents. Nevertheless, the parents were not keen on those options.

Currently, the girl is in her teens and very concerned with the aesthetics of the traumatised tooth. An oral examination showed that tooth 21 was labially placed from the arch alignment, discoloured and infra-occluded by 1.5 mm compared to the adjacent teeth (Fig. 1). The surrounding mucosa appeared healthy without pocketing. The firm tooth had a metallic sound heard upon percussion with a mouth mirror. A periapical radiograph showed evidence of RRR (Fig. 2). Her other teeth were sound. The girl's medical history and extraoral findings were unremarkable.



Fig. 1. Infra-occluded, discoloured and labially placed tooth 21.



Fig. 2. Periapical radiograph of tooth 21 showing replacement root resorption.

Once again, the parents were given treatment options to consider. The options include extraction of the tooth and replacement with either denture or fixed prosthesis; extraction of the tooth with orthodontic space closure and reshaping of adjacent teeth with crowns or veneers; extraction of the tooth and replacement with an implant; or aesthetic modification of the tooth with composite build-up. As the parents were financially challenged, they opted for the

aesthetic modification of the tooth with a composite build-up treatment option.

The overall procedure was carried out in two stages. In the first stage, we prepared a mock-up of the tooth modification model and constructed a transparent polypropylene thermoplastic template as a crown form. The second stage involved the composite build-up of tooth 21 using the transparent polypropylene thermoplastic template after tooth preparation.

Before the laboratory stage, alginate impressions (Algeniux® Major) of both maxillary and mandibular dentitions were taken. Working and study models were made from the impressions. The study model was used to analyse the orientation and interdigitation of the teeth and the amount of tooth structure that needs to be removed from the tooth. The labial surface of tooth 21 in the working model was reduced using a coarse diamond tapered fissure bur to a sufficient depth. Subsequently, the composite material was added in incremental layers to outline the desired tooth shape. A direct composite veneer template (U Veneer) was used to reproduce the labial surface of the model tooth 21 (Figure 3). The final shape, orientation and occlusion of tooth 21 on the working model were confirmed before constructing a transparent polypropylene thermoplastic template (Figure 4). A 1 mm thickness polypropylene sheet (Essix ACE® Plastic, Dentsply Sirona) was placed into the frame of a preheated vacuum thermoforming machine (Essix® Machine, Dentsply Sirona). The softened sheet was then lowered quickly over the stone cast under a vacuum suction until the sheet cooled. Finally, the formed polypropylene template was removed from the stone model and trimmed to the desired contour using scissors (Essix® Mayo scissors, Dentsply Sirona).



Fig. 3. Use of U Veneer shell to recreate the labial surface of tooth 21 on the working model.



Fig. 4. The final shape and orientation of tooth 21 on the working model.

During the clinical stage, a retraction cord was inserted into the gingival crevice around tooth 21. Labial surface reduction of tooth 21 was performed in two orientation planes. The depth of surface reduction ranges from 0.5 to 1.3 mm based on the planned reduction as in the working model. An equigingival chamfered edge finishing margin was placed gingivally. The prepared polypropylene template was placed over the teeth to check its fit (Fig. 5). Teeth adjacent to tooth 21 were isolated with Teflon tapes to prevent adhesion of composite to maintain the separation between teeth. The prepared incisal and labial surfaces of tooth 21 were etched

with 37% phosphoric acid (Super Etch™, SDI Limited Australia) for 20 seconds and later washed with a copious amount of water and gently dried to maintain a moist surface. A bonding agent (Stae™, SDI Limited Australia) was applied to the etched surfaces and light-cured for 20 seconds. Two tiny holes were made using a small round bur on the palatal aspect of the polypropylene template corresponding to tooth 21. Composite resin (Aura™, SDI Limited Australia) was placed into the crown template. Later, the template was gently placed over the teeth for composite adaptation and cured using a light cure through the transparent crown template. Upon curing, the crown template was removed, and the excess composite on the tooth was trimmed and polished (Fig. 6). The lateral excursions and forward protrusion jaw were checked to eliminate any heavy contacts. The patient was happy with the final appearance of the modified shape of the tooth. The restoration was intact with unaffected dental aesthetics at a 6-month follow-up.



Fig. 5. Fit check of the prepared polypropylene thermoplastic template before restoration.



Fig. 6. Final composite restoration of tooth 21.

III. DISCUSSION

External root resorption (ERR), which may occur in isolation as inflammatory root resorption (IRR) or replacement root resorption (RRR) or in combination, is a serious sequela of severe traumatic dental injuries [9]. Intrusive luxation injuries and reimplanted avulsed teeth were the leading causes of external root resorption, accounting for 90% of the cases [10]. Progressive external IRR, if not treated early, can lead to tooth mobility and early tooth loss.¹¹ Nevertheless, the progression of EIRR can be halted if early endodontic therapy is initiated [3], [11]. In the case of replacement root resorption (RRR), the affected tooth may remain asymptomatic. However, radiographic evidence will show root defects with loss of periodontal space demarcation with ingrowth of surrounding bone. The tooth will remain firm and produce a high-pitched metallic sound on percussion. Progressive RRR will shorten the root length and cause tooth loss [12]. The rate of RRR progression may vary from case to case, much faster in young children than adults [13]. Promptness of the emergency treatment instituted, severity of the damage to the periodontal ligament and root cementum, and the patient's age may dictate the rapidness of RRR destruction [12]. RRR is rapid in young and growing

children due to active bone remodeling, and it usually takes three to seven years for the affected teeth to be lost [13], [14]. Nonetheless, some of these teeth may survive longer than the predicted duration (9 years) [12].

RRR often leads to progressive infraocclusion of the affected tooth. The tooth will remain in its position compared to other unaffected adjacent teeth with jaw growth. It gives rise to functional and aesthetic deficits with distortion of the gingival margin and alveolus, resulting in a discrepancy in the smile arc [15]. Pre-adolescent children below ten years or before pubertal growth usually exhibit greater altered localized alveolus growth than skeletally matured adolescents. The adjacent teeth usually tilt toward the infraoccluded tooth space and cause space loss [16].

Traumatized infraoccluded teeth with RRR in adults are managed conservatively because the rate of root resorption is slow. The affected teeth are clinically monitored with radiographs annually to evaluate the changes in the crown height. Any crown height discrepancies will be corrected by adding composite to the incisal tips. If the resorption is extensive, other treatment options following extraction should be discussed with the patient to improve the aesthetic and functional aspects of the dentition [17].

In growing children and adolescents, traumatized infraoccluded teeth are instead treated actively, besides annual clinical and radiograph monitoring. As bone remodeling is active in this group of patients, often the degree of infraocclusion and rate of root resorption progresses rapidly. Treatment options include decoronation, autogenous tooth transplantation, intentional tooth extraction and reimplantation, distraction osteogenesis and early extraction and replacement with a prosthesis [8], [17]. However, none of these options is based on a strong evidence-based application other than successes reported in case reports or case series [7]. Nevertheless, decoronation and autogenous tooth transplantation are widely described procedures in the literature with some degree of success. Besides, the treatment chosen may be influenced by the clinician's skills, parental acceptance and the child's treatment compliance.

Decoronation of infraoccluded teeth with RRR allows vertical growth of the sockets because of the alveolus's growth potential in growing children and adolescents. The growth of the sockets allows maintenance of the ridge topography comparable to that of the adjacent teeth whilst the roots undergo continual resorption. The ridge conservation allows the replacement of the missing teeth with functional and aesthetic restorations [17].

Autologous transplantation of a tooth into the extracted infraoccluded tooth socket is also a viable option that can be considered. Usually, a single-rooted mandibular first or second mandibular premolar can be used for autotransplantation. However, this procedure requires a multidisciplinary team approach involving surgical, orthodontic, endodontic, and restorative expertise. The tooth selected to be autotransplanted must have an indication to be extracted, especially for an orthodontic need. Timing of the procedure is also crucial, usually performed when the tooth's root is two-thirds long, and the apex is open to ensure the viability of the pulp. Autotransplantation of teeth with matured roots may necessitate root canal therapy 10 to 14

days after the procedure. A long-term follow-up is needed to ensure the success of this treatment.

In the presented case, autologous tooth transplantation was impossible because the posterior teeth were in molar class I interdigitation and no extra tooth was available for autotransplantation. A decoronation option was also suggested, but the parents were not keen on the surgical procedure. Another option offered was extracting the infraoccluded tooth and orthodontic space closure. However, after a discussion with an orthodontist, this option was deemed to cause aesthetic disharmony because of the disproportion of the tooth size. Finally, the parents agreed to tooth modification using composite restoration. This option was preferred because it was inexpensive and did not require multiple visits to achieve the desired outcome.

Adhesive dentistry using composite has allowed the general population access to aesthetic dentistry at an affordable cost. The current advancements in composite technology have enabled dental practitioners to use materials of superior aesthetics with excellent optical properties [18]. The long-term stability of the composite restorations has also been clinically proven, mainly if appropriate case selection criteria were used [19]. The patient in the current case is from a lower-income family, so composite restorative material has benefited the patient's dental needs.

To obtain an acceptable aesthetic outcome, we used the composite tooth modification technique using a transparent thermoplastic polypropylene template [20], [21]. This technique involved two stages, the laboratory stage and the clinical stage. The diagnostic setup model and the transparent thermoplastic polypropylene template were prepared and constructed in the laboratory stage. We used a working model in the laboratory to determine the degree of tooth reduction and surfaces that need to be trimmed. Besides, the working model was also used as a diagnostic setup to establish the predicted outcome of the tooth modification. The U-Veneer transparent shell helped us recreate the labial tooth anatomy as close to the natural tooth surface. Once the desired outcome was confirmed, the transparent thermoplastic polypropylene template was constructed for clinical use.

In the clinical stage, the prepared template was used as a crown form to reproduce the anatomical tooth morphology. The produced template offers many advantages compared to the commercially available cellulose acetate crowns for restorations. The template prevents wastage of restorative material, and its transparent property allows curing light to penetrate through to cure the composite material sufficiently. The strength and flexibility of the constructed template allow easy placement and removal from the tooth with little distortion and tearing. Using the template minimizes unnecessary trimming of the placed restoration and provides an acceptable, marginal fit, thus reducing the chairside time needed.

IV. CONCLUSION

The transparent thermoplastic polypropylene template offers an alternative to conventional crowns to reconstruct tooth anatomy. The transparent thermoplastic polypropylene template is easy to construct, not expensive, able to reproduce

the desired size and shape of teeth, and is dimensionally stable and allows reusability if necessary.

FUNDING

The authors declare they received no funding from internal or external organizations.

CONFLICT OF INTEREST

The authors declare they do not have any conflict of interest.

REFERENCES

- [1] Lam R. Epidemiology and outcomes of traumatic dental injuries: a review of the literature. *Aust Dent J*. 2016; 61:4-20.
- [2] Kenny KP, Day PF, Sharif MO, Parashos P, Lauridsen E, Feldens CA, et al. What are the important outcomes in traumatic dental injuries? An international approach to the development of a core outcome set. *Dent Traumatol*. 2018; 34(1):4-11.
- [3] Blicher B. Differentiating resorptions. Available on: <https://www.aae.org/specialty/communicate/differentiating-resorption/>, accessed on 26 March 2023.
- [4] Zaleckiene V, Peculiene V, Brukiene V, Drukteinis S. Traumatic dental injuries: etiology, prevalence and possible outcomes. *Stomatologija*. 2014; 16(1):7-14.
- [5] Gupta T, Sadana G, Rai HK. Effect of esthetic defects in anterior teeth on the emotional and social well-being of children: a survey. *Int J Clin Pediatr Dent*. 2019; 12(4):229-232.
- [6] Rodd HD, Marshman Z, Porritt J, Bradbury J, Baker SR. Oral health-related quality of life of children in relation to dental appearance and educational transition. *Br Dent J*. 2011. doi:10.1038/sj.bdj.2011.574.
- [7] de Souza RF, Travess H, Newton T, Marchesan, MA. (2015). Interventions for treating traumatised ankylosed permanent front teeth. *Cochrane Database Systematic Review*. 2015;(12):CD007820. doi:10.1002/14651858.CD007820.pub3.
- [8] Rasarathnam L. (2016). Management options for the traumatised, intruded incisor in a growing patient. *FDJ Royal College of Surgeons England*. 2016; 7(3):116-120. doi:10.1308/rcsfdj.2016.116.
- [9] Galler KM, Grätz EM, Widbiller M, Buchalla W, Knüttel H. (2021) Pathophysiological mechanisms of root resorption after dental trauma: a systematic scoping review. *BMC Oral Health*. 2021;21:163. doi.org/10.1186/s12903-021-01510-6.
- [10] Soares AJ, Souza GA, Pereira, AC, Zaia, AA, Silva EJNL. (2015) Frequency of root resorption following trauma to permanent teeth. *J Oral Sci*. 2015;57(2):73-8. doi:10.2334/josnusd.57.73.
- [11] Abbott PV. (2016). Prevention and management of external inflammatory resorption following trauma to teeth. *Aust Dent J*. 2016;61 Suppl 1:82-94. doi:10.1111/adj.12400. PMID: 26923450.
- [12] Yoon H, Song M. Long-term retention of avulsed maxillary incisors with replacement root resorption: a 9-year follow-up. *Case Rep Dent*. 2021:8872859. doi.org/10.1155/2021/8872859.
- [13] Andersson L, Bodin I, Sörensen S. Progression of root resorption following replantation of human teeth after extended extraoral storage. *Endod Dent Traumatol*. 1989;5(1):38-47. doi: 10.1111/j.1600-9657.1989.tb00335.x.
- [14] Heithersay G S. (1985). Clinical endodontic and surgical management of tooth and associated bone resorption. *Int Endod J*. 1985; 18(2):72-92. doi: 10.1111/j.1365-2591.1985.tb00425.x.
- [15] Hadi A, Marius C, Avi S, Marriel W, Galit B-B. Ankylosed permanent teeth: incidence, etiology and guidelines for clinical management. *Med Dent Res*. 2018; 1(1):1-11. doi: 10.15761/MDR.1000101.
- [16] Campbell KM, Casas MJ, Kenny DJ. Ankylosis of traumatised permanent incisors: pathogenesis and current approaches to diagnosis and management. *J Can Dent Assoc*. 2005; 71(10):763-8.
- [17] Leziy S, Avera SP, Janakievski J, French D. What treatment options are available to manage trauma- induced dentoalveolar ankylosis in the growing individual? *Inside Dentistry*. 2018;14(10), <https://www.aegisdentalnetwork.com/id/2018/10>.
- [18] Nahsan FP, Mondelli RF, Franco EB, Naufel FS, Ueda JK, Schmitt VL, Baseggio W. Clinical strategies for esthetic excellence in anterior tooth restorations: understanding color and composite resin selection. *J Appl*

Oral Sci. 2012;20(2):151-156. doi:10.1590/s1678-77572012000200005.

- [19] Demarco FF, Collares K, Correa MB, Cenci, MS, de Moraes RR, Opdam NJ. (2017). Should my composite restorations last forever? Why are they failing? Critical review. *Braz Oral Res.* 2017; 31 (Suppl 1). doi.10.1590/1807-3107BOR-2017.vol31.0056.
- [20] Sockalingam SNMP, Zakaria ASL, Mahyuddin A, Kuppusamy E. Management of dental esthetics in a child with hypodontia using a heat vacuum-pressed transparent thermoplastic polypropylene template. *World J Dent.* 2021; 10.5005/jp-journals-10015-1843.
- [21] Sockalingam SNMP. Dental rehabilitation of amelogenesis imperfecta using thermoformed templates. *J Indian Soc Pedo Prev Dent.* 2011; 29(1):53–56. doi.org 10.4103/0970-4388.79938.